ANALYSIS OF RISK FACTORS ASSOCIATED WITH FATAL MOTOR VEHICLE COLLISIONS IN ARIZONA

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Abstract

In 2014, Arizona had 109,554 motor vehicle collisions (MVCs), 708 of which were fatal.[2] The objective of this study was to analyze behavioral patterns in drivers which resulted in fatal MVCs. This was a retrospective chart review of MVCs in 13 counties in Arizona from 2007 to 2015. Results showed a high incidence of high-risk behaviors due to substance use and lack of safe driving practices, including 26% of subjects with an ethanol content above the legal limit, 10% with THC in their system at the time of the collision, 9% with amphetamines or cocaine, 8.5% with benzodiazepines, and 5% with opiates. More than 50% of subjects had a combination of substances. Other notable characteristics were the lack of seatbelt use in 30% of subjects and the lack of motorcycle helmet use in 69% of motorcyclists. More data is needed on distracted driving behaviors, particularly related to cellular phone use, in order to optimally target future legislation and prevention.

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Introduction

The National Highway Traffic Safety Administration reports that there were 3,179 fatalities and 431,000 people injured due to distracted driving in 2014.[1] In 2014, Arizona had 109,554 motor vehicle collisions (MVCs), 708 of which were fatal.[2] This number rose to 116,609 collisions and 811 fatalities in 2015.[3] In Arizona, there were approximately 146 people injured daily in 2015 due to MVCs.[3] These injuries have significant social and financial impact. MVCs occur due to a myriad of reasons, including distractors while driving (e.g., eating, personal grooming such as combing hair or putting on make-up, changing the radio station), cellular phone use including texting, driving above the speed limit, weather or road conditions, vehicle malfunctions, or issues pertaining to a specific intersection.[4,5,6,7]

Prior studies have concluded that substance use, including polysubstance use with ethanol and drugs such as cocaine, amphetamines, marijuana, benzodiazepines, and barbiturates, is a major factor in causing both fatal and non-fatal MVCs.[8,9,10,11,12,13,14] A six year retrospective study in Milwaukee County found that 27% of drivers had polysubstance intoxication at the time of the fatal MVC, with alcohol being the most common, then THC, and thirdly, opioids; interestingly, they found that in 2016, drug use at the time of driving was more prominent than alcohol use at the time of driving.[15] The prevalence of opioid use is particularly important when considering substance abuse causing MVCs. A meta-analysis of 15 studies examining the association of prescription opioid use and MVCs concluded that the presence of opioids while driving significantly increased the risk of a motor vehicle collision.[16] A study additionally concluded that the use of prescription opioids was linked as a triggering factor in causing fatal two-vehicle collisions, particularly due to driving outside the lane.[17]

Other factors that resulted in an increased likelihood of a fatal MVC include being unrestrained or driving above the speed limit at the time of the collision.[5] Other less common factors precipitating fatal MVCs include medical conditions such as epilepsy[18], certain locations that are more prone to collisions[19], and a lack of vehicle sturdiness during the collision.[20] Cellular phone usage is also a factor that is becoming an increasingly common cause of MVCs, whether fatal or non-fatal.[21] A study in Bakersfield, CA with 514 subjects from pre-hospital

fatalities, specifically with central nervous system injuries, showed that the majority (53%) had an increased ethanol content during the time of the collision, while the second most common reason (45%) for the fatal MVC was texting while driving.[22]

Because behavioral patterns in drivers and driving laws have the potential to be altered, an association between these variables and motor vehicle fatalities is worthwhile to analyze for future accident prevention and increasing education.

Methods

This study was approved by the Institutional Review Board (IRB). This is a retrospective observational study and records from the Office of the Medical Examiner in 13 Arizona counties (Apache, Cochise, Coconino, Gila, Graham, Greenlee, La Paz, Navajo, Pima, Pinal, Santa Cruz, Yavapai, and Yuma) were collected for motor vehicle fatalities from January 2007 to December 2015, resulting in 350 subjects. All records that were available at the time of data collection were included in this study; the dates of the records used for each county and the number of subjects per county is listed in Table 1. Concentrated areas of demographic interest included age, sex, blood toxicology results, seatbelt use, and motorcycle helmet use. All aspects of the chart were examined, including whether other distractors, such as cellular phone usage, were present during the collision.

Table 1: Years of data obtained per Arizona county included in this study

County	**Years of data obtained**
Yavapai	2012-2015 (n=114)
Coconino	2007 (n=53)
Gila	2014-2016 (n=23)
Pima (includes Apache, Cochise, Graham, Greenlee, La Paz, Navajo, Pinal, Santa Cruz, and Yuma)	2015 (n=160)

Results

This study had a total of 350 subjects, 243 of which were men. The average age was 45 years old with a standard deviation of 20. The majority were pre-hospital fatalities (n=301). Mechanisms of injury are shown in Figure 1. The majority of subjects who were involved in an MVC (n=228) were drivers (n=128). There were fewer passengers (n=80) or those whose role in the collision was unknown (n=20). There were 42 subjects involved in a motorcycle collision, 35 pedestrians, 15 involved in an ATV or bicycle crash, 2 in a helicopter crash, and 28 of which the mechanism was unknown. A lack of seatbelt use was seen in 30% of subjects (n=90). Regarding motorcycle collisions, 69% of subjects (n=27) did not wear a helmet.

Overall, there was a high incidence of high-risk behaviors based on illegal substance use and lack of safe driving practices, as shown in Table 2. Toxicology analysis showed that 26% of subjects (n=91) had an ethanol content above the legal limit. Drug results include 10% of subjects with THC in their system at the time of the collision (n=38), 9% with amphetamines or cocaine (n=31), 8.5% with benzodiazepines (n=30), and 5% with opiates (n=18). More than 50% of subjects had a combination of the aforementioned substances, as opposed to solely one drug. Not all study subjects had blood toxicology tests completed at the time of autopsy, as this is dependent on the Office of the Medical Examiner per county, so there may be an increased number of subjects in each category.

The majority of subjects were younger than 65 years old (n=289). There were 17% of subjects (n=61) who were 65 years or older, and the majority of these subjects were involved in a motor vehicle collision (n=43, 70%). Only 10 of these subjects had positive toxicology results.

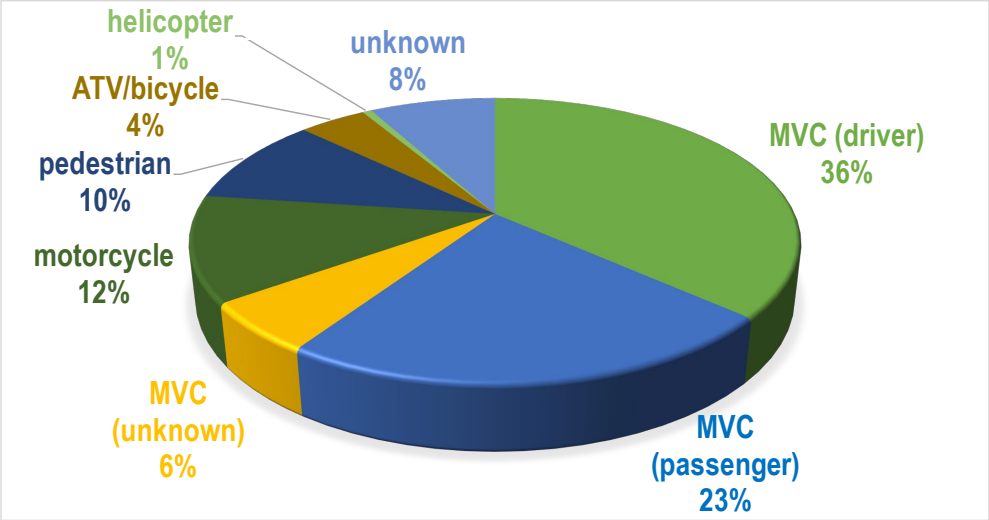

Figure 1: Mechanisms of injury

Table 2: Behavioral data of subjects

No seatbelt	N=90 (30%)
No helmet (motorcycle)	N=27 (69%)
EtOH above legal limit	N=91 (26%)
THC	N=38 (10%)
Amphetamines/cocaine	N=31 (9%)
Benzodiazepines	N=30 (8.5%)
Opiates	N=18 (5%)

Discussion

With the number of MVCs in Arizona rising from 109,554 in 2014 to 116,609 in 2015, as well as an increase in fatalities from 708 in 2014 to 811 in 2015[2], it is imperative to examine factors associated with these collisions as a preventative effort. Fatal collisions in 13 of 15 Arizona counties were primarily related to motor vehicle collisions rather than motorcycle collisions or other mechanisms of injury. Substance abuse including polysubstance high-risk behaviors based on the use of illegal substances prior to the fatal injuries, in particular a combination of ethanol, benzodiazepines, THC, amphetamines, cocaine, and opiates, was prominent.

Alcohol use while driving was present in over 25% of this study cohort. Multiple other controlled substances including opioids were present is smaller amounts, and polysubstance abuse was present in 50% of the cohort. These data represent an evolving epidemic that is being documented worldwide. Data from a recent survey study performed in Saudi Arabi documented a high incidence of polysubstance abuse while driving in a high-risk cohort.[23] Similarly a large national database study performed in Ibiza documented a high prevalence of alcohol and cocaine use involved in motor vehicle fatalities.[24] This worldwide growing public health issue is very complex and legislative factors will be key in addressing the high-risk behaviors.

Although not necessarily predominant in this study population, the lack of seatbelt use is another factor to take into consideration when discussing the fatality rates in MVCs, as this could potentially change the outcome of the collision, particularly if the subject was ejected from the vehicle. Seatbelt laws are already prominent in Arizona but it may be of benefit to have increasing educational efforts to the population, as well as further law enforcement. The lack of helmet use was predominant in the motorcycle fatalities, as the majority of motorcyclists were not wearing a helmet at the time of the collision. This is particularly important in Arizona, as the current law states that motorcyclists who are 18 years or older are not required to wear a helmet.[25] Because a motorcycle helmet could have potentially altered the outcome of the collision and a law for the general population in Arizona is not in place, it is

worthwhile to look at more detailed data in motorcycle collisions to determine if a change in legislation would be impactful.

Overall, the data from our study underscore the need for further preventative and educational measures related to substance use while driving, seatbelt use, and motorcycle helmet use. This study also points to the importance of potentially utilizing legislative changes in Arizona as a further preventive effort in curbing these fatalities.

Future directions

Limitations of this study include the nature of a retrospective chart review and the exclusion of two Arizona counties, including Maricopa County which is the most populous county in Arizona and resulted in 349 fatal MVCs in 2014, thus accounting for almost half of all Arizona MVCs.[2] Unfortunately, this county was excluded from this study due to circumstances pertaining to data collection. Because of the high rate of MVCs in Maricopa County, the rates of intoxication while driving and other distracted driving behaviors are potentially significantly higher than what is reported in this study.

More data is needed, particularly data related to cellular phone use while driving, including texting, dialing, and receiving phone calls, in order to optimally target future legislation and prevention. The addition of data from all counties in Arizona would also be beneficial in future studies.

Conclusion

This was a descriptive study based on a retrospective chart review that examined the association between driving behaviors and motor vehicle fatalities in Arizona. While substance use such as benzodiazepines, THC, amphetamines, cocaine, and opiates were found in many subjects, the largest percentage of substance use in those involved in a fatal MVC was an ethanol content above the legal limit or a combination of substances. Other behavioral modalities that should be utilized in future preventive efforts include seatbelt and motorcycle helmet use.

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